TECHNICAL EFFICIENCY OF TAPIOCA CULTIVATION IN

SALEM DISTRICT

K. ANITHA[1] & V. P. JAYALAKSHMI[2]

[1]Guest Lecturer of Economics, Government Arts College for women, Salem, Tamil Nadu, India

[2]Associate Professor & Head, Department of Economics, Government Arts College (Autonomous),

Salem, Tamil Nadu, India

ABSTRACT

This study examined the technical efficiency of Tapioca cultivation in Salem district. Technical efficiency is considered to be an important determinant of productivity growth and international competitiveness in any economy. It is also considered to be an important factor which contributes to the stability of production. The role of efficiency in increasing agricultural output has been widely recognized in both developed and the developing countries of the world In this study function of the Cobb-Douglas types was specified to estimate the technical efficiency of individual farms and crops for the selected areas in Salem District. Prior to the examination of the levels of technical efficiency between sample farms, an attempt has been made in the study to estimate the average output response to the changes in inputs at the existing state of technology. The Cobb-Douglas Production Function using Ordinary Least Square (OLS) technique was attempted to estimate the output elasticities with respect to the key inputs in the production of tapioca. Productivity improvements can be achieved by implementing policies, such as, improving farmers' access to extension services and technical assistance, to ensure farmers to use the existing technology more efficiently. This would make farmers operate more closely to the existing frontier.

KEYWORDS: Staple Food, Materials And Methods, Technical Efficiency & Stochastic Production

Original Article

INTRODUCTION

Cassava or Tapioca was introduced to India during the latter part of the eighteenth century. Tapioca (Manihot Esculenta Crantz) is an important staple food cum industrial crop of tropics. Its importance is now realized in tropical agriculture because of its drought tolerance and wider adaptability to varied soil, nutrient and agro climatic conditions. Economic yields could be obtained even in marginal lands and about 60% of the total biomass produced by the plant is stored in roots in the form of starch. More than 2/3 of the total production of tapioca in the world is used as human food, 5-7% as industrial raw material and the rest as animal feed.

Tapioca is a major horticulture crop cultivated on nearly 3 lakh hectares in the State, producing 60 lakhs tonnes of the crop. This is the major crop in the districts of Salem, Namakkal, Erode, Tiruvannamalai, Villupuram, Dharmapuri and Karur, and sustains more than three lakh farmers. Some 800 sago and starch factories depend on this crop. Salem has traditionally been known as the land of sago and starch. Tapioca cultivation is taken up by thousands of farmers in Salem district. In the district, out of the total 60,000 hectares coming under various horticulture crops, 22,000 hectares is under tapioca crop. Of which, 60 per cent of the area is irrigated and the remaining under rain-fed situations. In Salem about 650 units are engaged in tapioca processing. Moreover, the

Salem region offers a good raw material base, cheap labor and good sunshine throughout the year. All these factors provide a congenial environment for the growth of tapioca based products and have made this place famous for the same even at an international level. The cultivation of tapioca is manpower intensive only at the time of plantation and harvest. It provides a steady income to the farmers.

Technical efficiency refers to the ability of firms to employ the best practices in their production processes, so that not more than the necessary amount of a given set of inputs is used in producing the "best" level of output. A number of empirical studies have identified the sources of technical inefficiency, in addition to predicting the technical efficiencies for the firms. One of the earliest empirical studies in the stochastic frontier production function was an analysis of the sources of technical inefficiency in the Indonesian Weaving Industry by Pitt and Lee (1983). The study estimated a stochastic frontier production function by the method of maximum likelihood and the predicted technical efficiencies were then regressed upon some variables, including size, age and ownership structure of each firm, and were shown to have a significant effect on the degree of technical inefficiency of the firms. Many subsequent empirical studies have investigated the sources of technical inefficiency in different firms using the same two stage analytical methods. However, studies by Huang and Liu (1994) and Battese et al., (1996) have questioned the theoretical consistency of this two stages analytical technique and have proposed the use of stochastic frontier specifications which incorporate models for the technical inefficiency effects and simultaneously estimate all the parameters involved. Seyoum et al., (1998) using a one stage technical inefficiency model investigated the technical inefficiency and productivity of maize producers in Ethiopia and found technical inefficiency to be a decreasing function of the education of farmers and the number of hours of extension services but education was not significant for those farmers practicing traditional farming

According to literature, extension contacts enjoyed by farmers enhance their technical efficiency (Al-hassan, 2008 and Onumah et al., 2013. They observed that farmers learn new and improved methods of production from them. However, Onubuogu et al., (2014) in studying resource use efficiency of small holder cassava farmers in Oweri Agricultural Zone in Imo State, Nigeria concluded that the integrity of the Extension Officer is as important as the message they deliver. Because many farmers trivialise extension information on personal grounds which may render them technically inefficient despite the availability of extension officers. Many studies have reported a positive relationship between household size and technical efficiency (Al-hassan, 2008; Orewa et al., 2012). Also, Mailena et al., (2014) working on rice farms efficiency and factors affecting the efficiency in MADA Malasia, reported large households as being more technically efficient. They concluded that the households are a source of highly motivated family labour that does not have to be supervised to work hard.

MATERIAL AND METHODS

The study was carried out in pethanachanpalayam taluk of salem district. Among twelve taluks of Salem district pethanachanpalayam taluk has been specifically selected for the reason, it has recorded 3,108 hectares in the area of cultivation in 2018, which is the highest among the others. A multi-stage random sampling technique was employed in selecting the sample. Here the sample of 300 households was selected for the study. This study therefore examines the level of technical efficiency of tapioca cultivation in Salem district. There appears to be little previous application of stochastic frontier models in the analysis of the technical efficiency of tapioca cultivation in Salem.

For the present analysis, technical efficiency scores are estimated using a stochastic production function, of the following type;

$$In\,Y_i = \beta_o + \sum_{i=1}^{n} \beta_i \, InX_{ij} + \varepsilon_i \tag{1}$$

Where Y_i is the dependent variable (Tapioca output) and X_i are the independent variables viz., an area under crop, seed, family labor, hired labor, machine hours, chemical fertilizer and pesticide cost and *In* is the natural logarithm. The error (ε_i) is now defined as;

$$\varepsilon_i = v_i - u_i \tag{1a}$$

In this model, the dependent variable is bounded by the stochastic variable, $V_i - U_i$. The random error, V_i can be positive or negative and so the stochastic outputs vary about the deterministic part of the frontier model. V_i is the symmetric random error term distributed independently and identically [N (o, σ_v^2)] and captures errors beyond the farmer's control. U_i is the one sided production, distributed independently and identify with non-negative truncation of the normal distribution [N (o, σ_v^2)]. If the farm is inefficient (efficient), the actual output produced is less than (or equal to) the potential output. Therefore, the ratios of actual output and potential output can be treated as a measure of technical efficiency. Using the above equation 1, the technical efficiency (TE) of the ith farm is derived as: $TE_i = \exp(-U_i)$

The technical efficiency of the i-th farmer ($TE_i = \mu_i$) is derived from the density function of u and v which can be written as

$$F_u(u) = 1/\sqrt{\tfrac{1}{2}*\pi}).\ 1/\sigma_u.\ \exp.[-u^2/2\,\sigma_u^2]\ \text{for}\ u \leq 0 \tag{2}$$

$$= 0\ \text{otherwise}$$

$$F_v(v) = 1/\sqrt{\tfrac{1}{2}*\pi}).\ 1/\sigma_v.\ \exp.[-v^2/2\,\sigma_v^2]\ \text{for}\ -\infty \leq u \leq \infty \tag{2a}$$

The density function of y is the joint density function of (u+v) and is given by

$$F_v(y) = \pi\ .1/\sqrt{\tfrac{1}{2}*\pi})\ .\ 1/\sigma\ .\ \exp.\ \{(u+v)^2/2\,\sigma^2\}\ .$$

$$1 - f\{((u+v)/\sigma)\,(\gamma/1+\gamma))] \tag{3}$$

Where,

$$\sigma^2 = \sigma_u^2 + \sigma_v^2 \tag{4}$$

$$\gamma = \sigma_u^2/\sigma^2,\ 0 \leq \gamma \leq 1 \tag{4a}$$

Finally, γ is given by

$$\sigma^{ui} = -\sigma_u\sigma_v/\sigma[\{\varphi(.)/1-\varphi(.)\} - \{((u+v)/\sigma)\sqrt{(\gamma/1-\gamma)))] \tag{5}$$

where $\varphi(.)$ and $\varphi(.)$ are standard density and distribution functions, respectively.

TECHNICAL EFFICIENCY USING STOCHASTIC FRONTIER PRODUCTION FUNCTION

The Technical Efficiency of selected 300 sample farmers involved in tapioca production from Pethanachanpalayamtaluk of Salem District in Tamil Nadu was estimated by fitting a Stochastic Frontier Production Function. For the purpose of estimation, the area under tapioca cultivation, seed, organic manure, cost of chemical fertilizer, the cost of pesticide, machine hours used, family labour and hired labour were included as input variables.

An overview of the input and output of the selected farmer households of varying size groups of Pethanaickenpalayamtaluk of Salem District, is furnished in table 1

Table 1: Level of Input Use and Output Per Acre

Variables	PethanaickenpalayamTaluk				
	Land Size Group				
	<2.5	2.5-5.0	5.0-7.5	.5	All
Average area under tapioca crop in acre	2.11	4.51	7	10.2	5.25
Seed (no. of Karanai / Kuchi)	10491	10985	10163	10819	10469
Cost of Organic Manures	1233.96	1004.54	1030.79	1219.34	1097.66
Cost of Chemical Fertilizer	5727.91	5902.64	5279.95	4747.64	5562.34
Cost of Pesticide	1379.13	2134.32	1503.85	1698.33	1747.88
Family Labour Man-days	24.34	20.19	23.64	19.55	21.43
Hired Labour Man-days	43.23	48.17	49.89	51.61	49.11
Bullock- pairs	1	1	2	1	1
Machine hours	3.03	3.3	3.32	2.56	3.07
Total production in tonnes	11.15	11.86	11.22	11.99	11.56
Capital Cost (DIRTI-5)	1647.47	1912.19	1794.69	2048.03	1839.57
Farm Specific Variables					
Age	48.8	52.29	48.72	52.55	50.68
Education	6.27	6.69	7.23	8.38	6.94
family size	4.2	3.88	3.8	4.29	4
Farm Size	2.11	4.51	7	10.2	5.25

Source: Survey Data

It is clear from the above table. 1, the farmer has spent 49.11 man-days per acre of tapioca production from hired labor source. A higher amount of hired labor force participation in the Pethanaicken palayamtaluk might be due to their close accessibility to farms where the majority of the farmer are sheltered on. In the case of farms with more than 7.5 acres of tapioca cultivation, the hired labor force participation was found to be higher than the farms of less than 2.5 acres of tapioca cultivation. This might be due to the fact that their dependence on hired labor was relatively high as evidenced in the table. In other words, the family labor use per acre for tapioca cultivation in the taluk is found to be decreased with farm size, while an increasing trend was witnessed in the case of hired labor in the taluk. The machine hours used per acre tapioca cultivation was worked out to an average of about 4 hours, starting from ploughing to harvest here, in spite of the fact that marginal differences and witnessed between farm groups. The cost of plant nutrients in the form of NPK compounded fertilizer used per acre was found increased with farm size.

Per acre tapioca output was worked out to be the highest in the case of farms with more than 7.5 acres of tapioca cultivating the land. However, per acre tapioca output was found to be more. This might be due to the differences in the fertility of soil which gives more advantage to the farms, where tapioca is being cultivated as a single crop.

**Table 2: Parameters Estimation of the Stochastic Frontier
Production Function for Tapioca Cultivation**

Variables	Pethanachan Palayamtaluk		
	β	t	Sig.
Intercept	3.065	1.500	0.133
Area under tapioca cultivation	.0180	1.970	0.064
Seed (No. of Karanai / Kuchi)	0.735	2.780	0.005
Cost on organic manure	0.077	1.580	0.115
Chemical Fertilizer	0.012**	2.350	0.020
Cost on Pesticide Components	0.004	0.050	0.959
Machine Hours used	0.089*	2.960	0.003

Table 2: Contd.,			
Family Labour used in man-days	0.045***	1.650	0.099
Hired Labour used in man-days	0.092*	2.690	0.007
σ_v	0.137		
σ_u	0.248		
σ^2	0.080		
σ_v^2	0.019		
σ_u^2	0.061		
γ	0.763		
Log Likelihood	57.375		
N	300		

Source: Survey Data

Significant at 1 % level, ** Significant at 5 % level and *** Significant at 10 % level.

The maximum likelihood estimates of the stochastic frontier based on the sample farm level data obtained from the tapioca cultivating farmers of the Pethanachan palayamtalukin the table revealed the fact that many of the MLE estimates have expected signs and are significant, except for organic manure and pesticide components. A seed had the highest co-efficient (0.735) followed by hired labor (0.092) and machine hours (0.089). The sum of input coefficients indicates that the sample tapioca cultivating farmers in the taluk are operating at increasing return to scale. σ_u^2 and σ_v^2 are 0.061 and 0.019 respectively indicating the fact that differences between the observed output (tapioca) and frontier output is not due to the statistical variability alone but also due to technical inefficiency of farms in the area. The significant value of variance γ (0.763) indicates 76.30 percent of the difference between the observed and frontier output is primarily due to factors which are under the control of farms. Thus the tapioca production is witnessed with the operation of increasing returns to scale.

CONCLUSIONS

This study has analyzed the determinants of technical efficiency of tapioca cultivation in Salem district. The results show that the tapioca farmers are not fully technically efficient. To suggest that opportunities can still exist for tapioca farmers in the district to increase their efficiency levels by improving the ways in which resources are used at the farm level. The study also found that technical efficiency levels could be further increased by improving tapioca farmers access to inputs such as land and capital.

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